DOCUMENT RESUME

ED 268 176 TM 860 240

AUTHOR Campbell, N. Jo
TITLE Technical Characteristics of an Instrument to Measure Computer Anxiety of Upper Elementary and Secondary School Students.
PUB DATE Apr 86
NOTE 27p.; Paper presented at the Annual Meeting of the National Council on Measurement in Education (San Francisco, CA, April 17-19, 1986).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Anxiety; *Comparative Testing; *Computers; Intermediate Grades; Secondary Education; *Test Construction; Testing Problems; *Test Norms; Test Reliability; Test Validity
IDENTIFIERS *Computer Anxiety; *Computer Anxiety Scale

ABSTRACT

This study reports the preliminary results of a research project that focuses on the development of an abbreviated measure of computer anxiety, the Computer Anxiety Scale (CAS)-Short Form (SF), designed for use with upper elementary and secondary school students. The subjects involved in the study included 1075 students in grades 4 through 12, enrolled in six school districts in Kansas and Oklahoma. The internal reliability estimate of all student responses to the CAS and the CAS-SF are equivalent. Home ownership of a microcomputer and usage of a school microcomputer are significantly related to CAS-SF scores of both males and females, while grade level of the student is not significantly related to CAS-SF scores for either sex. Limited evidence of "face" validity is established. It is suggested that validity can be investigated by correlating scores on the computer anxiety measure to variables assumed to reflect anxiety and that the use of the State-Trait Anxiety Inventory and the Manifest Anxiety Scale along with the CAS-SF is needed to provide further evidence of validity. References, tables, and figures are appended. (Author/PN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED268176

Technical Characteristics of an Instrument to Measure Computer Anxiety of Upper Elementary and Secondary School Students

N. Jo Campbell

Oklahoma State University

Paper presented at the Annual Meeting of the National Council on Measurement in Education

April 1986

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

N. J. Campbell

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

TM 860 240

Abstract

As a result of the recent dramatic increase in the number of computers in schools and students' opportunities to develop computer literacy, it has become important to identify students who experience computer anxiety so that needed educational interventions can be implemented. This study reports the preliminary results of a research project having as a focus the development of an abbreviated measure of computer anxiety designed for use with upper elementary and secondary school students. The subjects involved in the study include 1075 students in grades 4 through 12 enrolled in six school districts in Kansas and Oklahoma. Frequency distributions of responses to the 18-item measure of computer anxiety developed in this study are presented. Estimates of internal reliability of the instrument are reported for males and females and upper elementary, junior high, and high school students. Limited evidence of validity is reported along with descriptions of possible research studies having the potential of providing increased evidence of validity.

Technical Characteristics of an Instrument to Measure Computer Anxiety of Upper Elementary and Secondary School Students

Computer literacy may soon become the type of "critical filter" for many careers that Sells (1973) has described knowledge of mathematics to be. Sanders (1984) believes that by the time the students in public schools today enter the job market, people who are not computer literate are very likely to be prevented from entering careers offering greater salary potential and higher job satisfaction. She wrote "Lack of computer skills is likely to relegate future workers to low-skill, low-pay jobs" (Sanders, 1984, p. 32).

Using computers in schools is a fairly recent development and research regarding the reasons students develop computer avoidance behaviors is very limited. As the number of computers in schools increases, and subsequently students' opportunities to develop computer literacy also increase (Bork, 1984), it becomes even more important to identify students who have fears and apprehensions regarding computers, defined by Maurer (1983) as computer anxiety, and may as a result of that anxiety choose not to study or use computers so that appropriate educational interventions can be implemented. Just as the learning of mathematics has been shown to be affected by math anxiety (Betz, 1978; Fennema & Sherman, 1977), it is very likely that computer anxiety affects both choosing to learn about computers and the mastery of computer skills.

This study reports the development and technical characteristics of an 18-item instrument designed to measure computer anxiety of upper elementary and secondary school students. The results are reported for male and female students in the upper elementary grades 4 through 6, junior high grades 7 through 9, and high school grades 10 through 12.

Methodology

Sample

The sample consisted of 1075 students in grades 4 through 12 in six school districts in Oklahoma and Kansas. Males composed 49% of the sample and females, 51% of the sample. No identified special education or gifted students participated in the study. The students represented a wide variety of backgrounds and academic interests. Availability of a computer at home was reported by 16% of the sample, while 33% indicated they used computers at school.

Instrumentation

The 30 item Computer Anxiety Scale (CAS) (Newman & Clure, 1984) was administered along with a short personal information questionnaire to all students within each selected classroom in the six school districts involved in the study. Participation on the part of all subjects was volunteered by teachers with administrative approval.

The 30 item Computer Anxiety Scale consists of 11 positively stated items and 19 negatively stated items. The subject is asked to indicate on a five point response scale ranging from "Always True" to "Never True" how closely the item describes him/herself. The following are examples of a positively stated item and a negatively stated item:

I think I could handle computer problems.

I'm not the type of person to do well on computers.

The weight of 5 is assigned to the response that is assumed to be indicative of a low level of apprehension regarding use of computers. To develop the measure of computer anxiety for each student, responses to the items were summed and divided by the number of responses actually marked, yielding a mean score for each student. Mean scores represent measures unaffected by omitted

responses. The greatest number of items omitted by any student was 7 items, and only a few students omitted more than 4 items. After collection of the instruments, internal reliability estimates were calculated for the CAS, and a principal components analysis with a varimax rotation was computed for all subjects using the SPSS-X Factor procedure (SPSS-X, 1983). Internal reliability estimates of responses to the abbreviated measure of computer anxiety, Computer Anxiety Scale, Short Form (CAS-SF), identified through a factor analysis of the CAS, were calculated using Cronbach's coefficient alpha (Cronbach, 1951) for all students, for each sex and for each grade level. Procedures appropriate for establishing the validity, to a limited degree, of the CAS-SF were also completed. Finally, frequency distributions of the mean scores on the CAS-SF were calculated by sex and grade and for all students.

Results

The internal reliability estimates of the CAS calculated using Cronbach's (1951) alpha are reported by sex and grade and for all subjects in Table 1. The principle components factor analysis of the CAS revealed the presence of two major factors composed of 18 items having factor loadings of .40 or higher on one of the two factors and four secondary factors composed of 2 to 4 items each. After reviewing the items composing the two major factors and accounting for 31% of the variance in the total scores on the CAS, it was decided to proceed with an investigation of the technical characteristics of this abbreviated form of the CAS. The proportion of positive to negative items in the CAS-SF is approximately the same as found in the CAS. The readability level of the CAS-SF was estimated to be 5.29 using the Dale-Chall method (Hunnicutt & Iverson, 1958). This method of determining readability is one of the most often used for materials designed for use with fourth grade through college level students. The internal reliability estimates, means and

standard deviations of the responses to the CAS-SF are also reported in Table 1 by sex and grade and for all subjects. The internal reliability estimates of the responses of all students to the CAS and the CAS-SF are equivalent, while the internal reliability estimates of the female students' responses are slightly higher than the internal reliability estimates of the responses of the male students for both forms. The responses of the elementary school students on the CAS have a lower internal reliability estimate than the responses of the junior high students which have a lower estimate of internal reliability than do the responses of the high school students. The estimates of internal reliability of responses to the CAS-SF are equivalent for the elementary and junior high students, while the responses of the high school students to the CAS-SF yield a higher estimate of internal reliability.

Insert Table 1 about here

The Pearson r correlations calculated between grade level and CAS-SF scores and between sex and CAS-SF scores are not significant ($p > .10$). Significant correlations were found between having a computer available in the home and CAS-SF scores ($r = -.18$, $df = 1041$, $p < .001$) and between use of a computer in school and CAS-SF scores ($r = -.15$, $df = 1023$, $p < .001$) for all students. These relationships were further examined by calculating point biserial correlation coefficients between CAS-SF scores and sex, home ownership of a microcomputer and usage of a computer at school for students in the elementary school grades of 4 through 6, the junior high school grades of 7 through 9, and the high school grades of 10 through 12. These results are reported in Table 2. None of the correlations calculated using data collected from the elementary students is significant at the .05 level. Home ownership

of a microcomputer and school usage of a microcomputer were both found to be significantly ($p < .01$) related to CAS-SF scores for both the junior high students and the high school students.

Insert Table 2 about here

The correlation coefficients calculated between CAS-SF scores and grade levels, home ownership of a microcomputer and usage of a microcomputer at school by males and females are reported in Table 3. Home ownership of a microcomputer and usage of a microcomputer at school are significantly ($p < .01$) related to CAS-SF scores of both males and females, while grade level of the student is not significantly ($p > .05$) related to CAS-SF scores for either sex. "Face" validity, a desirable but not sufficient type of validity, was established through a review of the items by a panel of three educators who hold graduate degrees and have worked extensively with computer applications in elementary and secondary school classrooms. They agreed the items appear to measure fears and apprehensions regarding computers.

Insert Table 3 about here

The frequency distributions of the mean scores on the CAS-SF and the corresponding histograms for all students, for males and females, and for each grade level are reported in Tables 4, 5, 6, 7, 8, and 9 and in Figures 1, 2, 3, 4, 5, and 6. Each of the score distributions tends to be negatively skewed.

Insert Tables 4, 5, 6, 7, 8, and 9 and

Figures 1, 2, 3, 4, 5, and 6 about here

Discussion

The abbreviated version of the CAS, the CAS-SF, appears to be a measure of computer anxiety for students in grades 4 through 12 that merits further study. The internal reliability estimates compare favorably to estimates reported by Cambre and Cook (1985) in their review of computer anxiety measures. The readability level of 5.29 is appropriate for use with upper elementary and secondary school students.

The results of studies by Gressard and Loyd (1984) and Jones (1983) were the basis for the research hypothesis of no relationship between CAS-SF scores and sex supported in this research. Further, but limited evidence of validity was obtained by the findings of significant relationships of CAS-SF scores with computer availability in the home and with use of a computer in school. These findings are consistent with the significant relationship between computer attitudes and computer experience reported by Gressard and Loyd (1984), Powers, et al. (1973), and Raub (1981). These researchers have reported that students who are more experienced using computers demonstrate less computer anxiety than students reporting little or no computer experience.

The shapes of score distributions reported for the CAS-SF are similar to the distribution of computer anxiety scores reported by Maurer (1983). When the opposite direction of scoring the CAS-SF and Maurer's computer anxiety are taken into consideration, the negative skewness of the score distributions of the CAS-SF and the score distribution reported by Maurer are the same.

A more intensive investigation of the validity of the CAS-SF is certainly warranted. Reviewers of this paper have questioned whether this scale measures anxiety about using computers or confidence based on experience with computers. Further investigations of validity could involve observed computer anxiety behavior as Maurer (1983) describes in his development of the Computer Anxiety Index. The observed behaviors could be scored according to the information provided by Maurer and correlated with CAS-SF scores.

Many anxiety scale development efforts such as those related to test anxiety and math anxiety have been based on research using the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970). Researchers (Raub, 1981; Maurer, 1983) involved in the development of computer anxiety inventories have also used the State-Trait Inventory in their research efforts directed toward the measurement of computer anxiety. Another anxiety measure which has been used as a criterion in the validation of many other measures of anxiety is the Manifest Anxiety Scale (Taylor, 1953). The use of the State-Trait Anxiety Inventory and the Manifest Anxiety Scale along with the CAS-SF is needed to provide further evidence of validity. As Cambre and Cook (1985) note, the validity of computer anxiety measures is difficult to establish but can be investigated by correlating scores on the computer anxiety measure to variables assumed to reflect anxiety.

References

Betz, N. E. (1978). Prevalence, distribution and correlates of math anxiety in college students. Journal of Counseling Psychology, 25, 441-448.

Bork, A. (1984). Computers in education today - and some possible futures. Phi Delta Kappan, 66, 239-243.

Cambre, M. A., & Cook, D. L. (1985). Computer anxiety: Definition, measurement, and correlates. Journal of Educational Computing Research, 1(1), 37-54.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, 297-334.

Fennema, E., & Sherman, J. (1976). Fennema-Sherman Mathematics Attitudes Scales: Instruments designed to measure attitudes toward the learning of mathematics by males and females. Washington, DC: Journal Supplement Abstract Service, American Psychological Association.

Gressard, C., & Loyd, C. G. (1984, April). An investigation of the effects of math anxiety and sex on computer attitudes. Paper presented at the meeting of the American Educational Research Association, New Orleans.

Hunnicutt, C. W., & Iverson, W. J. (Eds.). (1958). Research in the three R's. New York: Harper.

Jones, M. H. (1983). Sex differences in achievement on cognitive dimensions of computer literacy. Unpublished doctoral dissertation, University of Virginia - Charlottesville.

Maurer, M. M. (1983). Development and validation of a measure of computer anxiety. Unpublished master's thesis, Iowa State University.

Newman, D. L., & Clure, G. (1984, October). Computer anxiety in elementary school children: The development of an instrument and its correlates. Paper presented at the meeting of the Rocky Mountain Research Association, Oklahoma City.

Powers, W. G., et al. (1973, April). The effects of prior computer exposure on man-machine computer anxiety. Paper presented at the International Communication Association Convention, Montreal.

Raub, A. C. (1981). Correlates of computer anxiety in college students. Unpublished doctoral dissertation, University of Pennsylvania.

Sanders, J. S. (1984). The computer: Male, female or androgynous? The Computing Teacher, 11(8), 31-34.

Sells, L. W. (1973). High school mathematics as the critical filter in the jobmarket. (Available from Department of Sociology, University of California - Berkeley)

SPSS-X user's guide. (1983). New York: McGraw Hill.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press.

Taylor, J. A. (1953). A personality scale of manifest anxiety. Journal of Abnormal and Social Psychology, 48(2), 285-290.

Table 1

Means, Standard Deviations and Internal Reliability Estimates of Responses on the CAS and the CAS-SF

		All	Males	Females	Elem.	Jr. High	High School
CAS (30 items)	$\bar{X}$	3.71	3.66	3.76	3.67	3.74	3.70
	S	.60	.60	.60	.57	.56	.64
	r_{α}[a]	.88	.87	.90	.83	.86	.91
CAS-SF (18 items)	$\bar{X}$	3.71	3.69	3.73	3.63	3.77	3.67
	S	.71	.72	.69	.73	.66	.74
	r_{α}[a]	.88	.84	.89	.86	.86	.90

[a]Cronbach's coefficient alpha.

Table 2

Correlations Between Computer Anxiety and Sex, Home Ownership of a Microcomputer and Usage of a Microcomputer at School by Grade Levels

	Independent Variables		
Grade Level	Sex[a]	Home Ownership[b]	School Usage[b]
Elementary[c] N = 103	.05	-.18	-.01
Junior High[d] N = 486	.01	-.20*	-.10*
High School[e] N = 476	-.06	-.15*	-.23*

[a] Female = 0, Male = 1.

[b] Yes = 0, No = 1.

[c] Grades 4-6.

[d] Grades 7-9.

[e] Grades 10-12.

*$p < .01$.

Table 3

Correlations Between Computer Anxiety and Grade Levels, Home Ownership of a Microcomputer and Usage of a Microcomputer at School by Males and Females

	Independent Variables		
Sex	Grade Levels[a]	Home Ownership[b]	School Usage[b]
Males N = 523	-.05	-.25*	-.14*
Females N = 537	.01	-.12*	-.16*

[a] Grade levels 4 through 12.

[b] Yes = 0, No = 1.

*$p < .01$.

Table 4

Frequency Distributions of CAS-SF Mean Scores of All Students

$\bar{X}$	f	%	c%
4.51-5.00	149	13.8	100.0
4.01-4.50	270	25.1	86.2
3.51-4.00	274	25.5	61.0
3.01-3.50	223	20.7	35.4
2.51-3.00	126	11.7	14.6
2.01-2.50	20	1.8	2.9
1.51-2.00	10	.9	1.1
1.00-1.50	3	.2	.2

Table 5

Frequency Distributions of CAS-SF Mean Scores of High School Students

$\bar{X}$	f	%	c%
4.51-5.00	60	12.5	100.0
4.01-4.50	112	23.3	87.4
3.51-4.00	115	24.0	63.9
3.01-3.50	118	24.6	39.8
2.51-3.00	60	12.3	15.1
2.01-2.50	7	1.5	2.7
1.51-2.00	6	1.0	1.3
1.00-1.50	1	.2	.2

Table 6

Frequency Distributions of CAS-SF Mean Scores of Junior High School Students

$\bar{X}$	f	%	c%
4.51-5.00	74	15.2	100.0
4.01-4.50	133	27.4	84.9
3.51-4.00	131	27.0	57.5
3.01-3.50	85	17.5	30.5
2.51-3.00	51	10.5	13.0
2.01-2.50	9	1.9	2.5
1.51-2.00	2	.4	.6
1.00-1.50	1	.2	.2

Table 7

Frequency Distribution of CAS-SF Mean Scores of Elementary School Students

$\bar{X}$	f	%	c%
4.51-5.00	14	13.6	100.0
4.01-4.50	25	24.3	86.4
3.51-4.00	26	25.2	62.1
3.01-3.50	18	17.5	36.9
2.51-3.00	14	13.6	19.4
2.01-2.50	3	2.9	5.8
1.51-2.00	3	2.9	2.9
1.00-1.50	0	0.0	0.0

Table 8

Frequency Distribution of CAS-SF Mean Scores of Male School Students

$\bar{X}$	f	%	c%
4.51-5.00	79	15.1	100.0
4.01-4.50	126	24.1	84.9
3.51-4.00	131	25.0	60.8
3.01-3.50	96	18.4	35.8
2.51-3.00	75	14.3	17.4
2.01-2.50	8	1.5	3.1
1.51-2.00	6	1.1	1.5
1.00-1.50	2	.4	.4

Table 9

Frequency Distribution of CAS-SF Mean Scores of Female Students

$\bar{X}$	f	%	c%
4.51-5.00	66	12.3	100.0
4.01-4.50	142	26.5	87.7
3.51-4.00	140	26.1	61.2
3.01-3.50	123	22.9	35.1
2.51-3.00	51	9.5	12.1
2.01-2.50	11	2.1	2.6
1.51-2.00	3	0.6	0.6
1.00-1.50	0	0.0	0.0

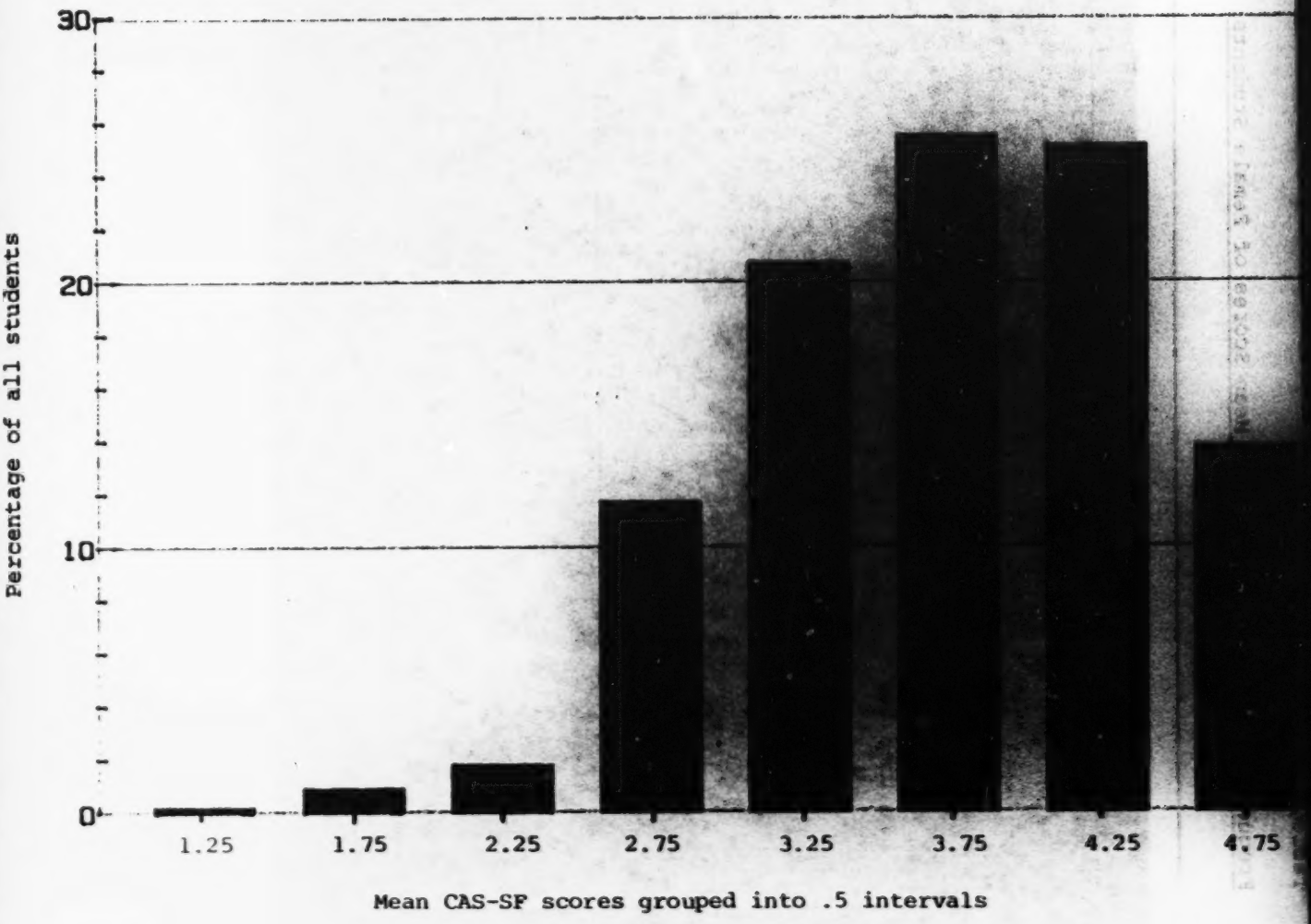

Figure 1. Distribution of CAS-SF mean scores of all students.

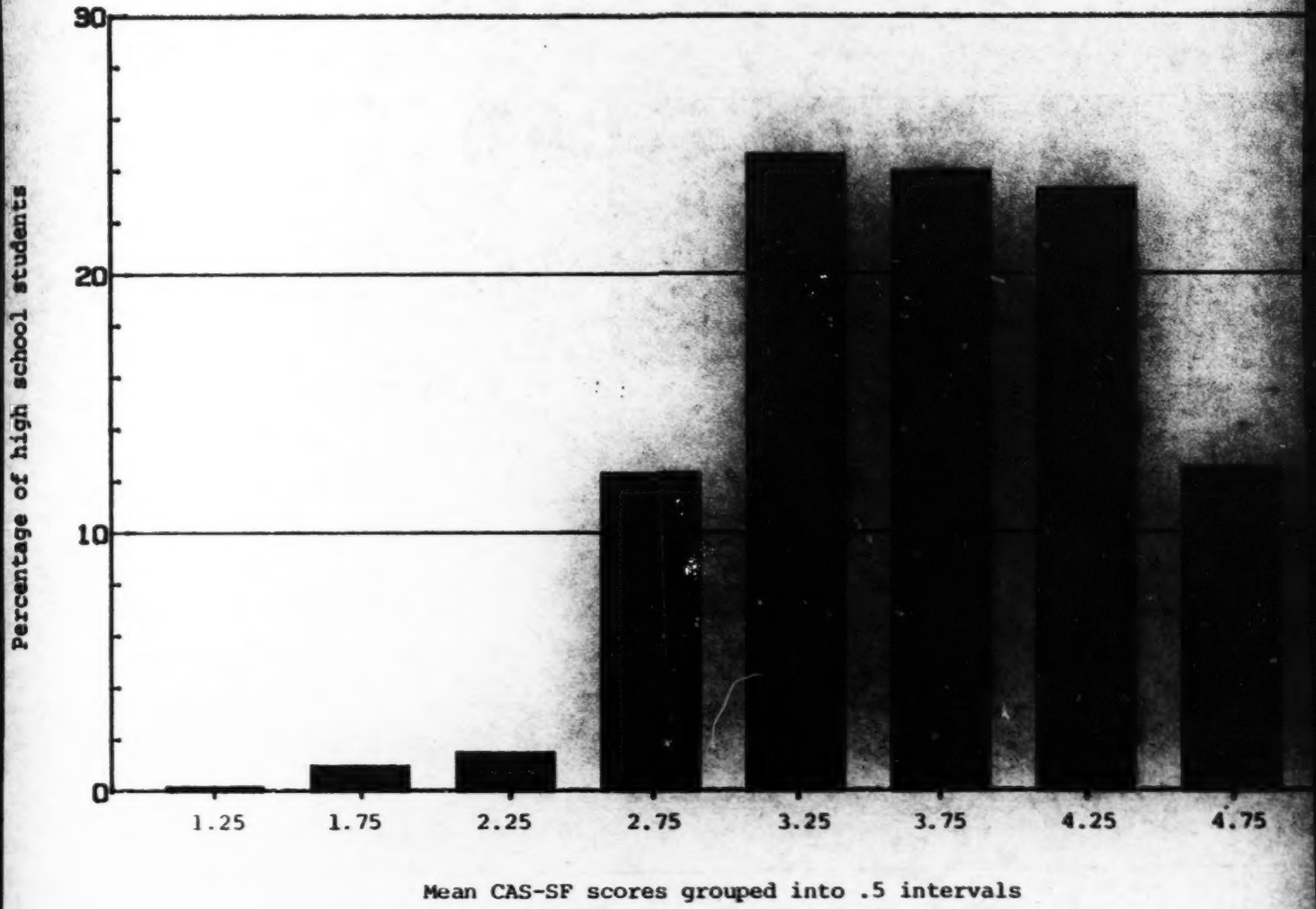

Figure 2. Distribution of CAS-SF mean scores of high school students.

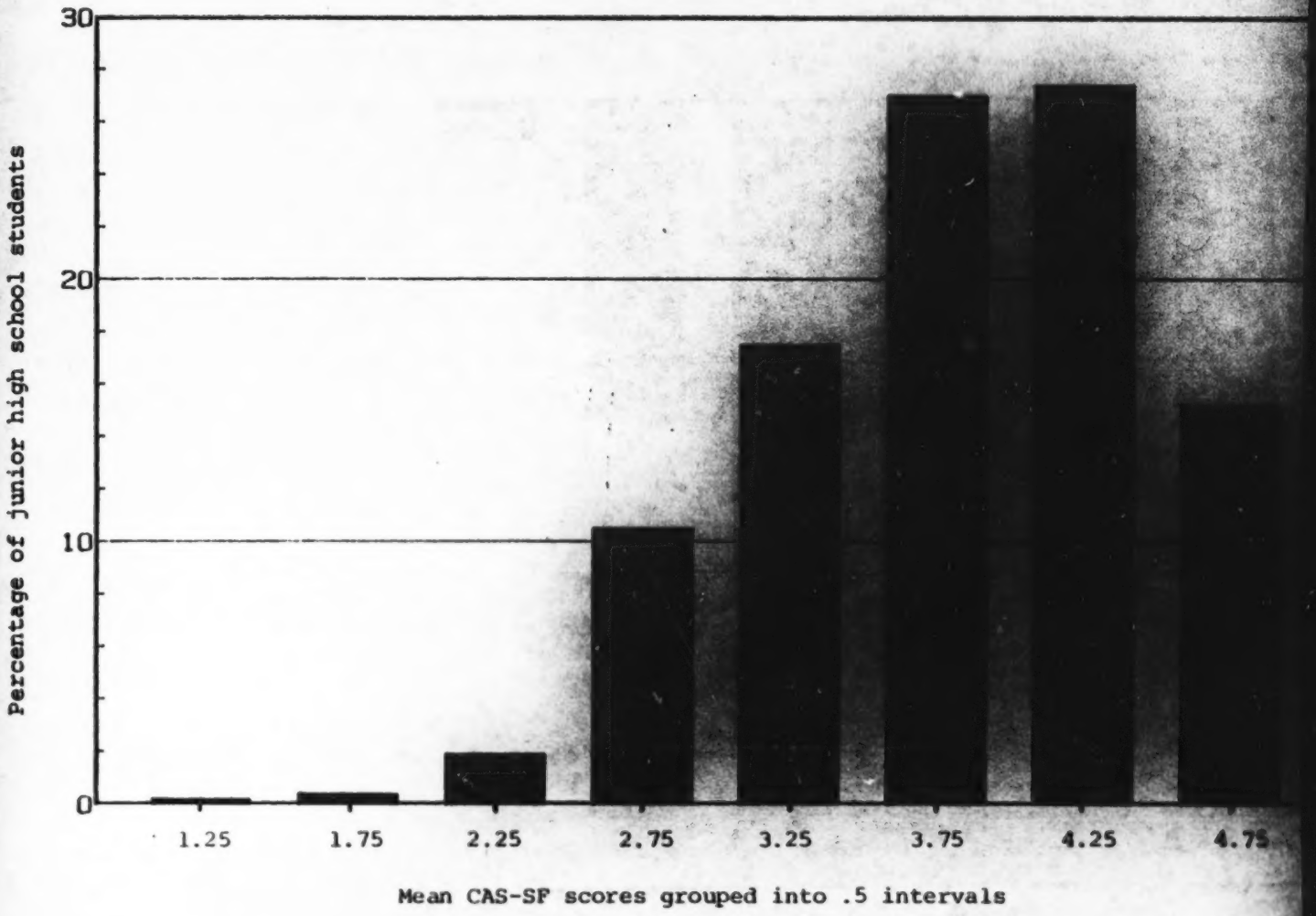

Figure 3. Distribution of CAS-SF mean scores of junior high school students.

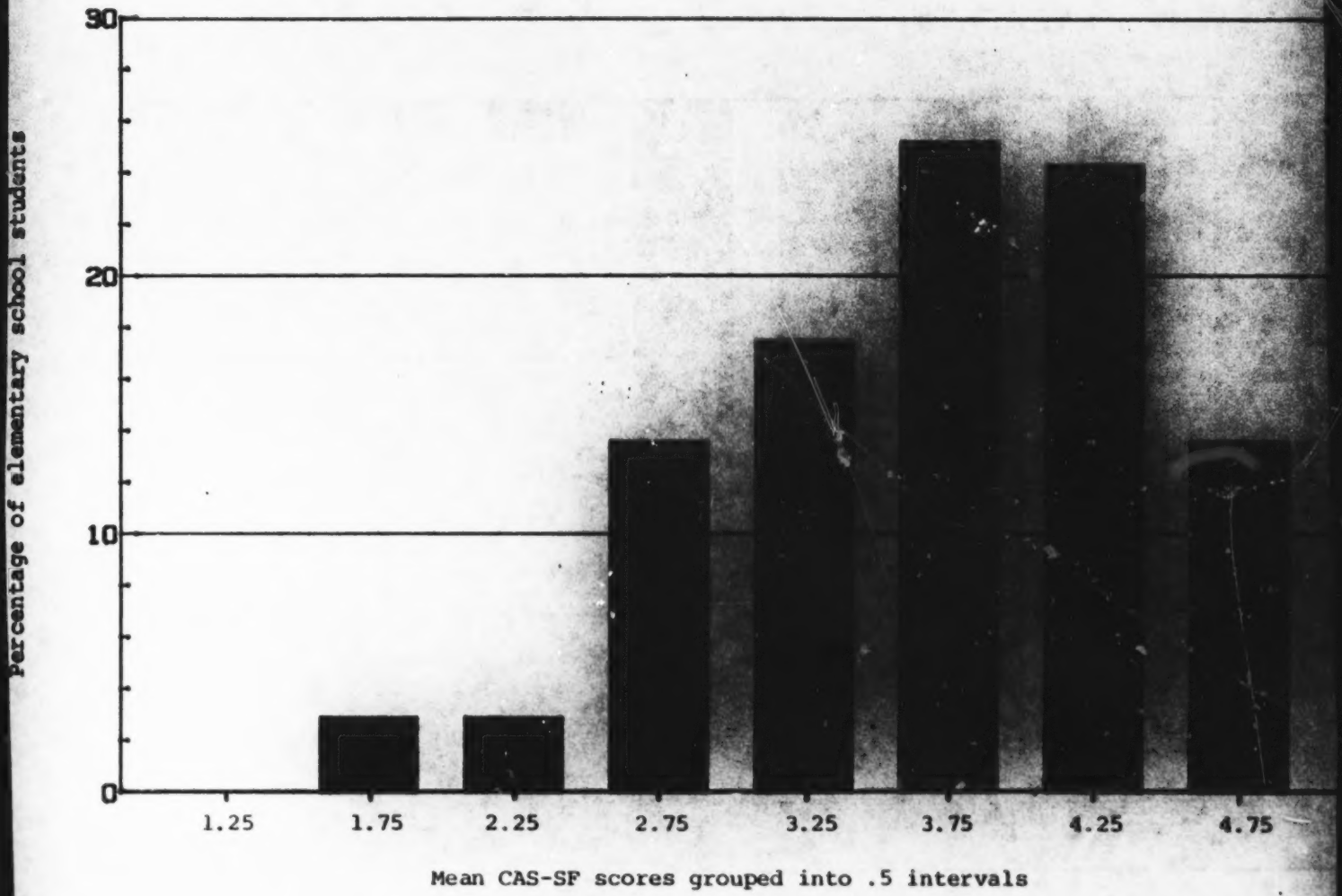

Figure 4. Distribution of CAS-SF mean scores of elementary school students.

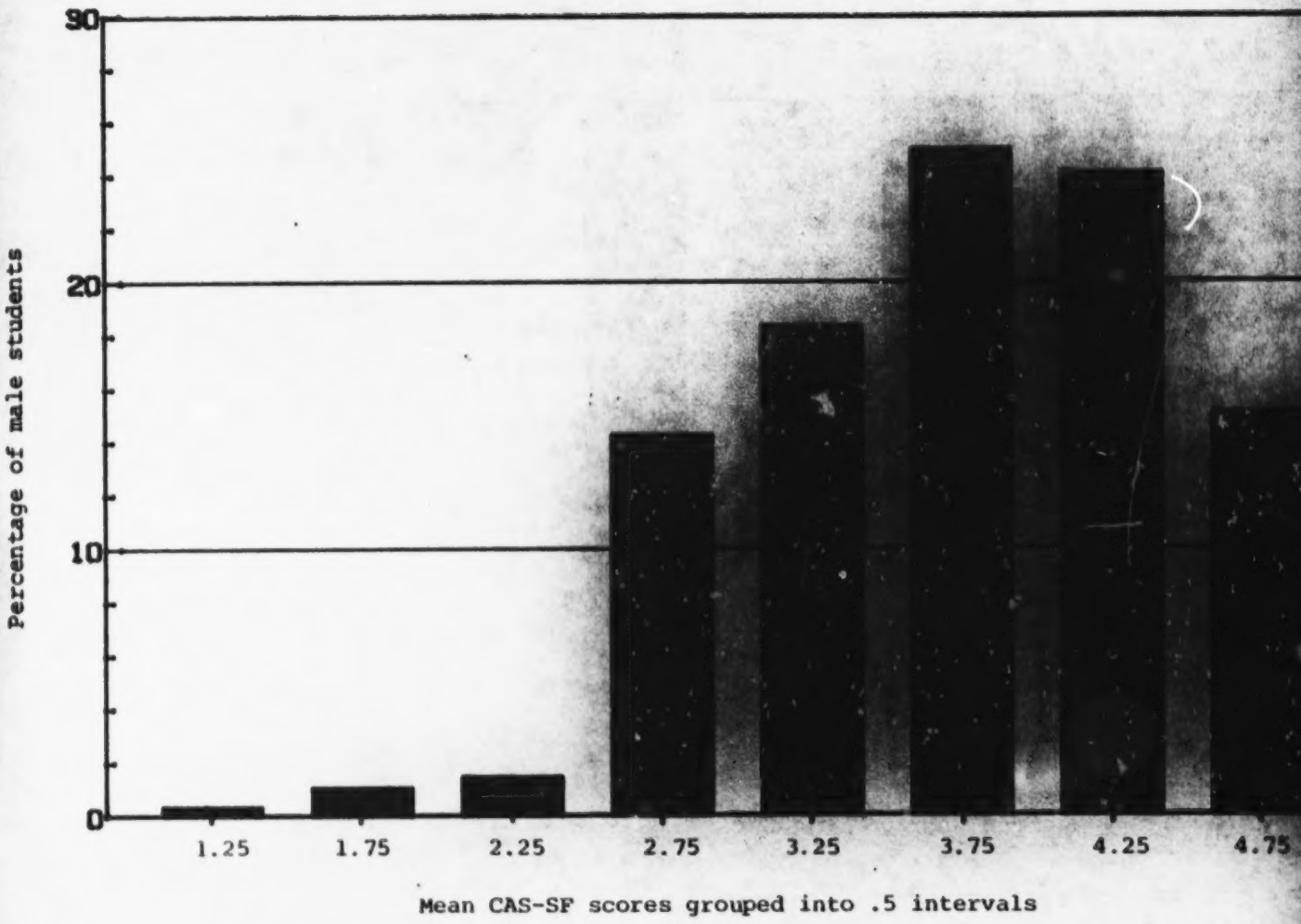

Figure 5. Distribution of CAS-SF mean scores of male students.

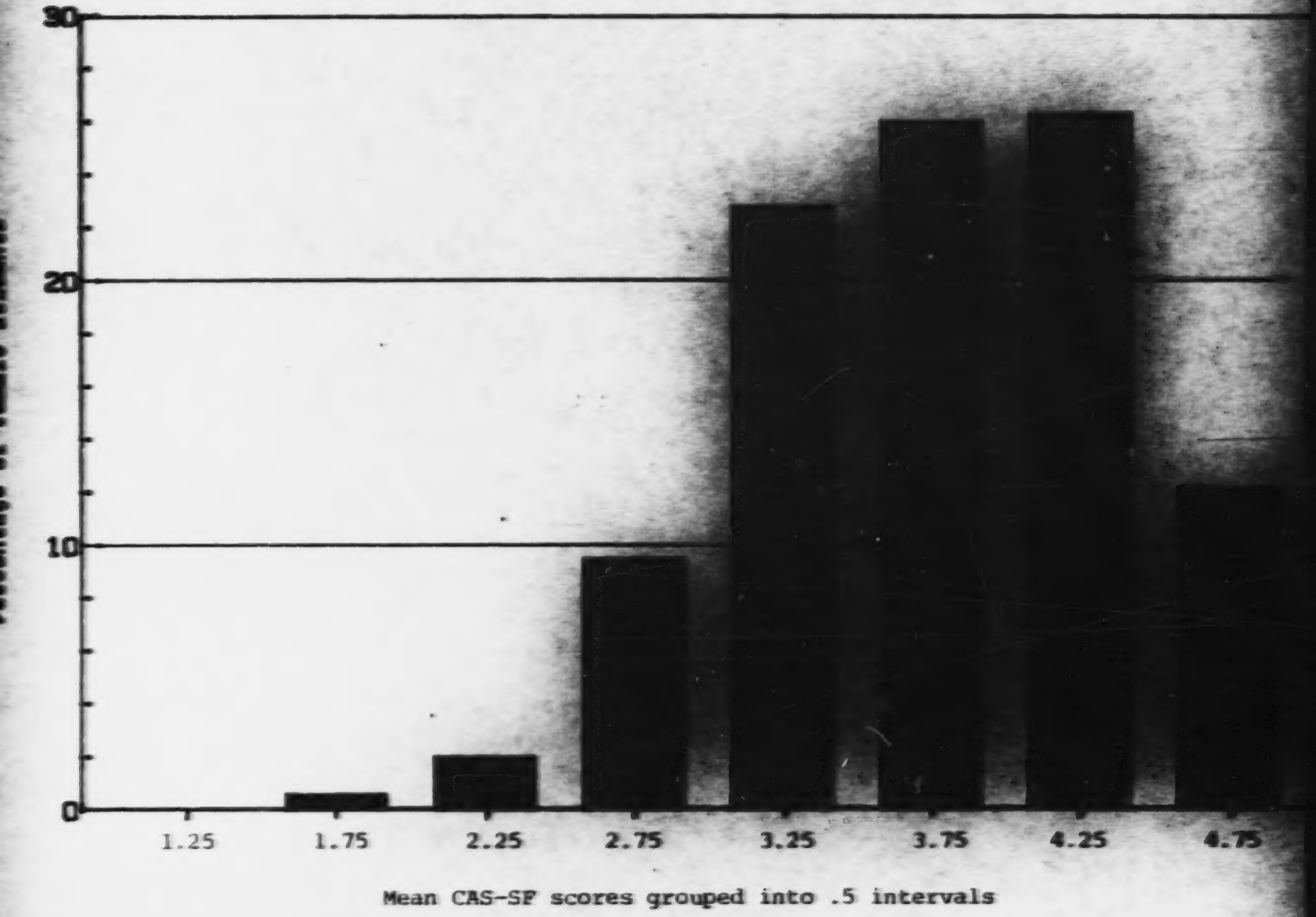

Figure 6. Distribution of CAS-SF mean scores of female students.